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08/973618

PCT/SE97/00885

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 20 January 1998 (20.01.98)	
International application No. PCT/SE97/00885	**Applicant's or agent's file reference** P 97-161/LK
International filing date (day/month/year) 27 May 1997 (27.05.97)	**Priority date** (day/month/year) 29 May 1996 (29.05.96)
Applicant LEIJON, Mats et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   19 December 1997 (19.12.97)

   [ ] in a notice effecting later election filed with the International Bureau on:

   _____

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes	Authorized officer Nicola Wolff

8240

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P 97-161/LK /uh

Box No. I TITLE OF INVENTION

A HYDRO-GENERATOR PLANT

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

Asea Brown Boveri AB

S-721 83 VÄSTERÅS
Sweden

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

LEIJON, Mats

Hyvlargatan 5

S-723 35 VÄSTERÅS
Sweden

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

L.A.GROTH & Co.KB
KARLSSON, Leif et al.
Box 6107
S-102 32 STOCKHOLM
Sweden

Telephone No. +46 - 8 - 729 91 00

Facsimile No. +46 - 8 - 31 67 67

Teleprinter No.

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

HERNNÄS, Bo
Cedergatan 27

S-723 41 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

CARSTENSEN, Peter
Sjövägen 62

S-141 42 HUDDINGE
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

HÖLLELAND, Mons
Fornforskargatan 52

S-723 53 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
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- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

TEMPLIN, Peter
Dybecksgatan 4 B

S-731 40 KÖPING
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

GERTMAR, Lars
Humlegatan 6

S-722 26 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

IVARSON, Claes
Barkarö Bygatan 221

S-725 91 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

SÖRENSEN, Erland
Gudruns väg 32

S-723 55 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
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- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

DAVIDSSON, Gunnar
Förmansgatan 14

S-724 66 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Sheet No. 4

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

KYLANDER, Gunnar
Stentorpsgatan 16 A

S-723 43 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

LARSSON, Bertil
Sammetsvägen 12

S-724 76 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

BERGGREN, Sören
Vetterstorpsgatan 30

S-724 62 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

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BERGGREN, Bertil
Rönnbergagatan 2 B

S-723 46 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Continued on another continuation sheet

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

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NYGREN, Jan-Anders
Karlfeldtsgatan 27 B

S-722 22 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

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RYDHOLM, Bengt
Brunnbygatan 68

S-722 23 VÄSTERÅS

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
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- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

KALLDIN, Hans-Olof
Grenadjärgatan 9

S-723 46 VÄSTERÅS
Sweden

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☐ the United States of America only
- ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF S[redacted]ES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP ARIPO Patent: KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania .....
- ☒ AM Armenia .....
- ☒ AT Austria .....
- ☒ AU Australia .....
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina
- ☒ BB Barbados
- ☒ BG Bulgaria .....
- ☒ BR Brazil .....
- ☒ BY Belarus
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China .....
- ☒ CU Cuba .....
- ☒ CZ Czech Republic and utility model .....
- ☒ DE Germany and utility model .....
- ☒ DK Denmark and utility model .....
- ☒ EE Estonia .....
- ☒ ES Spain .....
- ☒ FI Finland and utility model .....
- ☒ GB United Kingdom
- ☒ GE Georgia .....
- ☒ HU Hungary .....
- ☒ IL Israel .....
- ☒ IS Iceland
- ☒ JP Japan .....
- ☒ KE Kenya .....
- ☒ KG Kyrgyzstan .....
- ☒ KP Democratic People's Republic of Korea .....
- ☒ KR Republic of Korea .....
- ☒ KZ Kazakstan .....
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho .....
- ☒ LT Lithuania
- ☒ LU Luxembourg .....
- ☒ LV Larvia
- ☒ MD Republic of Moldova .....
- ☒ MG Madagascar .....
- ☒ MK The former Yugoslav Republic of Macedonia .....
- ☒ MN Mongolia
- ☒ MW Malawi .....
- ☒ MX Mexico .....
- ☒ NO Norway
- ☒ NZ New Zealand .....
- ☒ PL Poland .....
- ☒ PT Portugal .....
- ☒ RO Romania
- ☒ RU Russian Federation .....
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia .....
- ☒ SK Slovakia .....
- ☒ TJ Tajikistan .....
- ☒ TM Turkmenistan .....
- ☒ TR Turkey .....
- ☒ TT Trinidad and Tobago .....
- ☒ UA Ukraine .....
- ☒ UG Uganda .....
- ☒ US United States of America .....
- ☒ UZ Uzbekistan .....
- ☒ VN Viet Nam .....

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☒ YU Jugoslavien (fr. 1997-02-01)
- ☒ GH Ghana (AP) (fr. 1997-02-26)
- ☐ .....
- ☐ .....

In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of _____.

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

See Notes to the request fo

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country *(in which, or for which, the application was filed)*	Filing Date *(day/month/year)*	Application No.	Office of filing *(only for regional or international application)*
item (1) Sweden	29 May 1996 (29.05.1996)	9602079-7	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s) : (1)

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / SE

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office):	Date *(day/month/year)*:	Number:
Sweden	29 May 1996	SE 96/00648

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	7	sheets
2. description	10	sheets
3. claims	4	sheets
4. abstract	1	sheets
5. drawings	5	sheets
Total	27	sheets

This international application is accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☐ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☐ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☐ other *(specify)*:

Figure No. 2 of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

L.A.GROTH & Co.KB

Leif Karlsson

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

5620

08/973018

PATENT COOPERATION TREATY

PCT

REC'D 08 OCT 1998

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P97-161/LK/PA	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/SE97/00885	International filing date *(day/month/year)* 27.05.97	Priority date *(day/month/year)* 29.05.96
International Patent Classification (IPC) or national classification and IPC6 H02K 3/40		
Applicant ASEA BROWN BOVERI AB et al		

RECEIVED
99 JAN 13 AM 11:31
TECHNOLOGY CENTER 2800

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
19.12.1997	21.09.1998
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Håkan Sandh Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/Se97/00885

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*.

☒ the international application as originally filed.

☐ the description, pages 1-10 , as originally filed,
pages _____ , filed with the demand,
pages _____ , filed with the letter of _____ .
pages _____ , filed with the letter of _____ .

☒ the claims, Nos. _____ , as originally filed,
Nos. _____ , as amended under Article 19,
Nos. _____ , filed with the demand,
Nos. 1-36 , filed with the letter of 31.08.1998 .
Nos. _____ , filed with the letter of _____ .

☒ the drawings, ~~sheets~~/fig 1-7 , as originally filed,
~~sheets~~/fig _____ , filed with the demand
~~sheets~~/fig _____ , filed with the letter of _____ .
~~sheets~~/fig _____ , filed with the letter of _____ .

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE97/00885

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-36	YES
	Claims		NO
Inventive step (IS)	Claims	1-36	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-36	YES
	Claims		NO

2. Citations and explanations

The invention relates to a hydro-generator plant including a rotating electrical machine. The winding of the machine is provided with an insulation system comprising two semiconducting layers with solid insulation inbetween.

Documents cited in the International Search Report:

(A) US A 4429244
(B) US A 5036165
(C) US A 4091139

(A) describes a stator with a high-voltage winding for a generator. The insulation of the winding is thick in the bottom of the slot and is then reduced towards the inner periferi of the stator.

(B) describes a cable provided with two semiconducting layers with insulation there between. The semiconducting layers include pyrolized organic material and glass fibre. In this document it is suggested that the invented semiconducting layer can be applied to insulated conductors such as a winding in a dynamo-electric machine.

(C) describes highvoltage windings with semiconducting layers.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

The claimed invention differs from the cited art in that the winding of the machine is provided with an insulation system comprising two semiconducting layers with solid insulation in-between.

Even though it is suggested in document (B) to apply a semiconducting layer to a winding in a dynamo-electric machine there is no specific indication of using the disclosed cable in a dynamo-electric machine. Further investigating US 4853565, incorporated by reference in dokument (B), the skilled person will find it evident that the invented semiconducting layer is intended to be used on a conventional winding in a machine or in a cable. There is no proposal to use the cable with the insulating system as a winding in an electric machine. Nor can it be considered obvious to a person skilled in the art to use such a cable in a dynamo-electric machine since at the time of the invention it was not known to use a cable with solid insulation as a winding in an electrical machine and there is no teaching in the prior art as a whole that would lead the skilled person to the claimed invention.

Accordingly, the invention claimed is novel and involves an inventive step. The invention is industrially applicable.

PCT/SE 97/00885

31 -08- 1998

AMENDED CLAIMS

1. A hydro-generator plant comprising at least one rotating electric machine (100) for high voltage, in which the generator is coupled to a turbine (102) via shaft means (101), said generator (100) comprising at least one winding, characterized in that the winding includes a high-voltage cable with an insulation system comprising at least two semiconducting layers, each layer constituting essentially an equipotential surface, and also intermediate solid insulation, and in that each winding is arranged to be directly connected via coupling elements (109) to a transmission or distribution network (110) having a voltage of between 20 and 800 kV, preferably higher than 36 kV.

2. A plant as claimed in claim 1, characterized in that at least one of the layers has substantially the same coefficient of thermal expansion as the solid insulation.

3. A plant as claimed in either of claims 1 or 2, characterized in that the generator comprises a magnetic circuit with a magnetic core.

4. A plant as claimed in claim 3, characterized in that the flux paths in the core of the magnetic circuit consist of laminated sheet and/or cast iron and/or powder-based iron, and/or rough forge iron.

5. A plant as claimed in any of claims 1-4, characterized in that the solid insulation is built up of a cable (6) intended for high voltage comprising one or more current-carrying conductors (31) surrounded by at least two semiconducting layers (32, 34) and intermediate insulating layers (33) of solid insulation.

6. A plant as claimed in claim 5, characterized in that the innermost semiconducting layer (32) is at substantially the same potential as the conductor(s) (31).

7. A plant as claimed in either claim 5 or claim 6, characterized in that one of the outer semiconducting layers (34) is arranged to form essentially an equipotential surface surrounding the conductor(s) (31).

8. A plant as claimed in claim 7, characterized in that said outer semiconducting layer (34) is connected to a predefined potential.

9. A plant as claimed in claim 8, characterized in that the predefined potential is earth potential.

10. A plant as claimed in any of claims 5-9, characterized in that at least two of said layers have substantially the same coefficient of thermal expansion.

11. A plant as claimed in any of claims 5-7, characterized in that the current-carrying conductor comprises a plurality of strands, only a few of the strands being uninsulated from each other.

12. A plant as claimed in any of claims 1-11, characterized in that the winding consists of a cable comprising one or more current-carrying conductors (2), each conductor consisting of a number of strands, an inner semiconducting layer (3) being arranged around each conductor, an insulating layer (4) of solid insulation being arranged around each inner semiconducting layer (3) and an outer semiconducting layer (5) being arranged around each insulating layer (4).

13. A plant as claimed in claim 12, characterized in that the cable also comprises a metal screen and a sheath.

14. A plant as claimed in any of the preceding claims, characterized in that its stator (1) is cooled at earth potential by means of a flow of gas and/or liquid.

15. A plant as claimed in any of the preceding claims, characterized in that the outermost semi-conductor (34) is connected to earth potential.

16. A plant as claimed in any of the preceding claims, characterized in that the rotor (2) is inductively connected to the high voltage.

17. A plant as claimed in claim 16, characterized in that the rotor (2) is cylindrical in shape, has salient poles and also has a constant air gap.

18. A plant as claimed in claim 17, characterized in that the stator winding is carried out with integral slot winding.

19. A plant as claimed in claim 17, characterized in that the stator winding is carried out with fractional slot winding.

20. A plant as claimed in claim 18 or claim 19, characterized in that the stator has concentrated winding

and that coils in the winding have a coil span equal to the pole pitch.

21. A plant as claimed in claim 18 or claim 19, characterized in that the coils in the stator winding are distributed and have a coil span different from the pole pitch.

22. A plant as claimed in any of claims 5-21, characterized in that the cables (6) with solid insulation have a conductor area of between 40 and 3000 mm^2 and have an outer cable diameter of between 20 and 250 mm.

23. A plant as claimed in claim 22, characterized in that the cable (6) is cooled by gas or liquid inside the current-carrying conductors (31).

24. A plant as claimed in any of the preceding claims, characterized in that the electric generator (100) is designed for high voltage and arranged to supply the out-going electric network (110) directly without any intermediate connection of a transformer.

25. A plant as claimed in any of the preceding claims, characterized in that it comprises several generators, each of which lacks an individual step-up transformer, but which, via a system transformer common to the generators, is connected to the transmission or distribution network.

26. A plant as claimed in claim 24, characterized in that at least one generator (100) is earthed via an impedance (103).

27. A plant as claimed in claim 24, characterized in that at least one generator (100) is directly earthed.

28. A plant as claimed in any of claims 24-27, characterized in that it is designed to be driven alternatively as pump and turbine station, the electric machine (100) being arranged to function as motor driven directly from the electric power network (110) or as generator generating voltage for the electric power network.

29. A plant as claimed claim 24, characterized in that the generator is arranged to generate power to various voltage levels.

30. A plant as claimed claim 29, characterized in that one of said voltage levels is arranged to generate auxiliary power and that the auxiliary power is arranged to be generated from a separate winding (119;113) in the generator (100).

31. A plant as claimed in any of claims 1-30, characterized in that all components are earthed to the same earth system.

32. A plant as claimed in any of the preceding claims, characterized in that the winding of the generator is arranged for self-regulating field control and lacks auxiliary means for control of the field.

33. Procedure for constructing a plant as claimed in any of claims 1-32, characterized in that the stator of the generator is delivered in parts to the plant site, said parts comprising separate stator laminations and/or combined stacks of stator laminations, after which said parts are assembled on site, and in that both threading of the winding and any splicing required are performed on site.

34. An electric generator (100) for high voltage included in a hydro-generator plant in which the generator is coupled to a turbine (102) via shaft means (101), said generator (100) comprising at least one winding, characterized in that the winding includes a high-voltage cable with an insulation system comprising at least two semiconducting layers, each layer constituting essentially an equipotential surface, and also intermediate solid insulation, and in that each winding is arranged to be directly connected via coupling elements (109) to a transmission or distribution network (110) having a voltage of between 20 and 800 kV, preferably higher than 36 kV.

35. A generator as claimed in claim 34, characterized in that it includes the features defined for the generator included in the plant as claimed in any of claims 2-32.

36. A procedure for manufacturing a generator as claimed in claim 34 or 35, characterized in that said manufacture includes the measures for assembly of the generator which are defined in claim 33.

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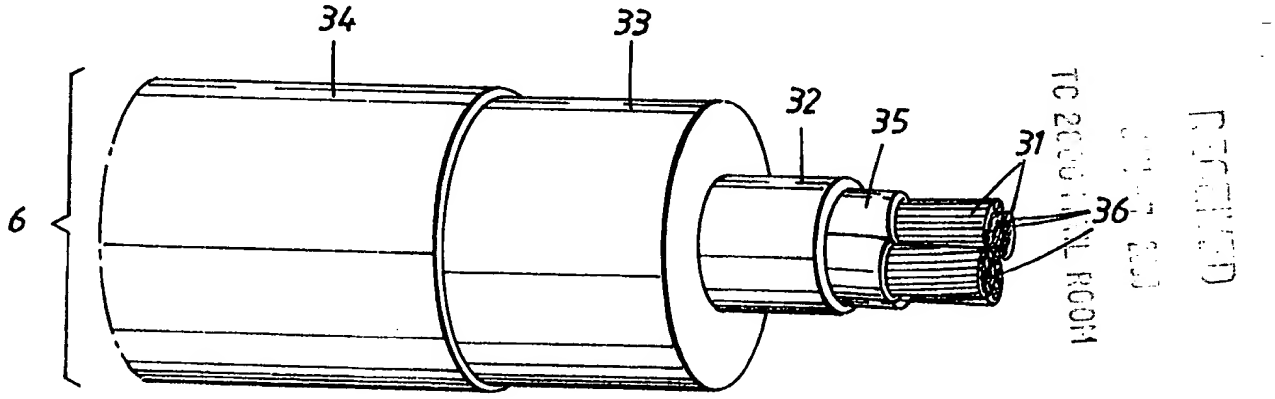

(57) Abstract

The magnetic circuit of a generator in a hydro-generator plant is arranged to directly supply a high supply voltage of 20-800 kV, preferably higher than 36 kV. The generator is provided with solid insulation and its winding includes a cable (6) comprising one or more current-carrying conductors (31) with a number of strands (36) surrounded by at least one outer and one inner semiconducting layer (34, 32) and intermediate insulating layers (33). The outer semiconducting layer (34) is at earth potential. The stator winding may be produced with full or fractional slot winding, the phases of the winding being Y-connected. The Y-point may be insulated and protected from over-voltage by means of surge arresters, or else the Y-point may be earthed via a suppression filter. The invention also relates to a hydro-generator plant, a generator included in the plant and a procedure for building such a plant.

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A HYDRO-GENERATOR PLANT

Technical field:

The present invention relates to a hydro-generator plant of the type described in the preamble to the claim and which is intended for connection to distribution or transmission networks, hereinafter called power networks. The invention also relates to an electric generator for high voltage in a hydro-generator plant intended for the above-mentioned purpose. The invention further relates to a procedure for assembling such a plant and the manufacture of such a generator.

Background art:

The magnetic circuits in electric generators usually comprise a laminated core, e.g. of sheet steel with a welded construction. To provide ventilation and cooling the core is often divided into stacks with radial and/or axial ventilation ducts. For larger machines the laminations are punched out in segments which are attached to the frame of the machine, the laminated core being held together by pressure fingers and pressure rings. The winding of the magnetic circuit is disposed in slots in the core, the slots generally having a cross section in the shape of a rectangle or trapezium.

In multi-phase electric generators the windings are made as either single or double layer windings. With single layer windings there is only one coil side per slot, whereas with double layer windings there are two coil sides per slot. By coil side is meant one or more conductors combined vertically or horizontally and provided with a common coil insulation, i.e. an insulation designed to withstand the rated voltage of the generator to earth.

Double-layer windings are generally made as diamond windings whereas single layer windings in the present context can be made as diamond or flat windings. Only one (possibly two) coil width exists in diamond windings whereas flat windings are made as concentric windings, i.e. with widely varying coil width. By coil width is meant the distance in arc dimension between two coil sides pertaining to the same coil.

Normally all large machines are made with double-layer winding and coils of the same size. Each coil is placed with one side in one layer and the other side in the other layer. This means that all coils cross each other in the coil end. If there are more than two

layers these crossings complicate the winding work and the coil end is less satisfactory.

It is considered that coils for rotating generators can be manufactured with good results within a voltage range of 3 - 20 kV.

It is also generally known that connection of a synchronous machine to a power network must be via a Δ/Y-connected or step-up transformer, since the voltage of the power network is generally higher than the voltage it has hitherto been able to achieve with the electric machine. Thus this transformer and the synchronous machine constitute integrated parts of a plant. The transformer entails an extra cost and also has the drawback that the total efficiency of the system is reduced. If, therefore, it were possible to manufacture electric generators for considerably higher voltages, the step-up transformer could be eliminated.

Although the dominant known technology for supplying current from a generator to a high-voltage network, a concept which in the present application applies to the level of 20 kV and upwards, preferably higher than 36 kV, is for a transformer to be inserted between the generator and the power network, it is already known to attempt to eliminate the transformer and generate the high voltage directly out to the power network at its voltage level. Such generators are described, for instance, in US-A-4 429 244, US-A-4 164 672 and US-A-3 743 867.

However, the machine designs according to the above publications do not permit optimal utilization of the electromagnetic material in the stator.

Description of the invention:

The object of the invention is thus to provide an electric generator which can be used in a hydro-generator plant for such high voltage that the above-mentioned Δ/Y-connected step-up transformer can be omitted, i.e. a plant in which the electric generators are intended for considerably high voltages than conventional machines of corresponding type, in order to be able to execute direct connection to power networks at all types of high voltage.

This object has been achieved according to the invention in that a plant of the type described in the preamble to claim 1 is given the special features defined in the characterizing part of this claim, in that a generator of the type described in the preamble to claim 34 is given the special features defined in the characterizing part

of this claim, and in that a procedure of the type described in the preamble to claims 33 and 36 includes the special measures defined in the characterizing parts of respective claims.

Thanks to the solid insulation in combination with the other features defined, the network can be supplied without the use of an intermediate step-up transformer even at network voltages considerably in excess of 36 kV.

The fact that the solid insulation enables the windings to be arranged for direct connection to the high-voltage network, thus eliminating the step-up transformer, offers great advantages over known technology.

The elimination of the transformer per se entails great savings, for instance, and the absence of the transformer also results in several other simplifications and thus savings.

A plant of this type is often arranged in a rock chamber where, with conventional technology, the transformer is arranged either in direct connection with the generator in the rock chamber or above ground at a distance of several hundred metres and connected to the generator by a busbar system. Compared with the first alternative, elimination of the transformer enables the volume of the rock chamber to be greatly reduced. The fire risk entailed with an oil-insulated transformer is also eliminated therefore reducing the necessity for extensive fire-safety precautions such as special evacuation routes for personnel.

In the alternative in which the transformer is placed above ground the busbar system is more extended due to the longer distance between the generator and the transformer. Since the current in the busbars (normally with aluminium conductors) is considerable, in the order of 10-20 kA, the power losses are large. Moreover, busbar systems introduce a risk for 2- and 3-phase faults during which the currents are considerable.

With the present invention two major objectives are achieved:
- The losses in the busrun are reduced due to the high voltage.
- The risk for 2- and 3-phase failures is considerably reduced due to the use of insulated HV cables.

The reduction in the number of electrical components achieved with the invention therefore means that the corresponding safety equipment can be omitted.

Furthermore, the rock chamber need not be blasted to allow laying of the busbar system, which entails a saving in rock chamber space of several thousand cubic metres.

The plant according to the invention also enables several connections with different voltage levels to be arranged, i.e. the invention can be used for all auxiliary power in the power station.

In all, the advantages mentioned above entail radically improved total economy for the plant. The plant cost, typically in the order of some hundred million SEK, is reduced by 30-50 %. Operating economy is improved both by less need for maintenance and by an increase in the degree of efficiency by 1-1.5 %. For an operating time of 8000 h/year, an output level corresponding to 150 MVA, a kWh price of SEK 0.20 and a useful service life of 30 years the gain would be approximately SEK 75 - 100 million per generator.

In a particularly preferred embodiment of the plant and generator respectively, the solid insulation system comprises at least two layers, each layer constituting essentially an equipotential surface, and also intermediate solid insulation therebetween, at least one of the layers having substantially the same coefficient of thermal expansion as the solid insulation.

This embodiment constitutes an expedient embodiment of the solid insulation that in an optimal manner enables the windings to be directly connected to the high-voltage network and where harmonization of the coefficients of thermal expansion eliminates the risk of defects, cracks or the like upon thermal movement in the winding.

It should be evident that the windings and the insulating layers are flexible so that they can be bent.

It should also be pointed out that the plant according to the invention can be constructed using either horizontal or vertical generators, which may be of either underground or aboveground type.

The above and other preferred embodiments of the invention are defined in the dependent claims.

The major and essential difference between known technology and the embodiment according to the invention is thus that this is achieved with a magnetic circuit included in an electric generator which is arranged to be directly connected via only breakers and isolators to a high supply voltage in the vicinity of between 20 and 800 kV, preferably higher than 36 kV. The magnetic circuit thus comprises

a laminated core having at least one winding consisting of a threaded cable with one or more permanently insulated conductors having a semiconducting layer both at the conductor and outside the insulation, the outer semiconducting layer being connected to earth potential.

To solve the problems arising with direct connection of electric machines to all types of high-voltage power networks, the generator in the plant according to the invention has a number of features as mentioned above, which differ distinctly from known technology. Additional features and further embodiments are defined in the dependent claims and are discussed in the following.

Such features mentioned above and other essential characteristics of the generator and thus of the hydro-generator plant according to the invention include the following:

- The winding of the magnetic circuit is produced from a cable having one or more permanently insulated conductors with a semiconducting layer at both conductor and sheath. Some typical conductors of this type are PEX cable or a cable with EP rubber insulation which, however, for the present purpose are further developed both as regards the strands in the conductor and the nature of the outer sheath.

- Cables with circular cross section are preferred, but cables with some other cross section may be used in order to obtain better packing density, for instance.

- Such a cable allows the laminated core to be designed according to the invention in a new and optimal way as regards slots and teeth.

- The winding is preferably manufactured with insulation in steps for best utilization of the laminated core.

- The winding is preferably manufactured as a multi-layered, concentric cable winding, thus enabling the number of coil-end intersections to be reduced.

- The slot design is suited to the cross section of the winding cable so that the slots are in the form of a number of cylindrical openings running axially and/or radially outside each other and having an open waist running between the layers of the stator winding.

- The design of the slots is adjusted to the relevant cable cross section and to the stepped insulation of the winding. The

stepped insulation allows the magnetic core to have substantially constant tooth width, irrespective of the radial extension.

- The above-mentioned further development as regards the strands entails the winding conductors consisting of a number of impacted strata/layers, i.e. insulated strands that from the point of view of an electric machine, are not necessarily correctly transposed, uninsulated and/or insulated from each other.

- The above-mentioned further development as regards the outer sheath entails that at suitable points along the length of the conductor, the outer sheath is cut off, each cut partial length being connected directly to earth potential.

The use of a cable of the type described above allows the entire length of the outer sheath of the winding, as well as other parts of the plant, to be kept at earth potential. An important advantage is that the electric field is close to zero within the coil-end region outside the outer semiconducting layer. With earth potential on the outer sheath the electric field need not be controlled. This means that no field concentrations will occur either in the core, in the coil-end regions or in the transition between them.

The mixture of insulated and/or uninsulated impacted strands, or transposed strands, results in low stray losses.

The cable for high voltage used in the magnetic circuit winding is constructed of an inner core/conductor with a plurality of strands, at least two semiconducting layers, the innermost being surrounded by an insulating layer, which is in turn surrounded by an outer semiconducting layer having an outer diameter in the order of 20-200 mm and a conductor area in the order of 40-3000 mm^2.

The solid insulation in a generator according to the invention also offers great advantages when constructing a hydro-generator plant. The absence of wet insulation means that the stator of the generator need not be completed at the factory but can instead be delivered in parts and assembled on site. A stator of the size under consideration here is large and heavy which has entailed transport problems with conventional designs where the roads must be reinforced and dimensioned for the vast weight. This problem is eliminated since the stator for a generator can be delivered in parts.

The invention thus also relates to the procedures as defined in claims 30 and 33, where this possibility is exploited when building

a hydro-generator plant and manufacturing a generator, respectively.

Brief description of the drawings:

The invention will be described in more detail in the following detailed description of a preferred embodiment of constructing the magnetic circuit of the electric generator in the hydro-generator plant, with reference to the accompanying drawings in which

Figure 1 shows a schematic axial end view of a sector of the stator in an electric generator in the hydro-generator plant according to the invention,

Figure 2 shows an end view, partially stripped, of a cable used in the winding of the stator according to Figure 1,

Figure 3 shows a simplified view, partially in section, of a hydro-generator arrangement according to the invention,

Figure 4 shows a circuit diagram for the hydro-generator plant according to the invention,

Figure 5 shows a section through a conventional hydro-generator plant.

Figure 6 is a diagram showing a traditional solution for auxiliary power for a hydro plant, and

Figure 7 is a diagram showing generators with build-in windings for generation of auxiliary power according to the invention.

Description of a preferred embodiment:

In order to understand certain aspects of the advantages of the invention, reference is made initially to Figure 5 showing an example of a conventional hydro-generator plant. This is of a type with the transformer hall 501 situated some way from the generator hall 502, the latter being in the form of a rock chamber housing the generator 503. The generator 503 is connected to the transformer in the transformer hall 501 via a busbar system 505 arranged in a tunnel system 504 several hundred metres long. A plant according to the invention entirely eliminates the part to the right of the line A-A in Figure 5, while substantially the same dimensions are retained in the generator hall 502. A conventional plant without the transformer situated above ground as shown in Figure 5 would instead require a considerably larger generator hall

502 to allow space for the transformer and its auxiliary and safety equipment.

The rotor 2 of the generator is also indicated in the schematic axial view through a sector of the stator 1 according to Figure 1, pertaining to the generator 100 (Figure 3) included in the hydro-generator plant. The stator 1 is composed in conventional manner of a laminated core. Figure 1 shows a sector of the generator corresponding to one pole pitch. From a yoke part 3 of the core situated radially outermost, a number of teeth 4 extend radially in towards the rotor 2 and are separated by slots 5 in which the stator winding is arranged. Cables 6 forming this stator winding, are high-voltage cables which may be of substantially the same type as those used for power distribution, i.e. PEX cables. PEX = crosslinked polyethylene (XLPE). One difference is that the outer, mechanically-protective sheath, and the metal screen normally surrounding such power distribution cables are eliminated so that the cable for the present application comprises only the conductor and at least one semiconducting layer on each side of an insulating layer. Thus, the semiconducting layer which is sensitive to mechanical damage lies naked on the surface of the cable.

The cables 6 are illustrated schematically in Figure 1, only the conducting central part of each cable part or coil side being drawn in. As can be seen, each slot 5 has varying cross section with alternating wide parts 7 and narrow parts 8. The wide parts 7 are substantially circular and surround the cabling, the waist parts between these forming narrow parts 8. The waist parts serve to radially fix the position of each cable. The cross section of the slot 5 also narrows radially inwards. This is because the voltage on the cable parts is lower the closer to the radially inner part of the stator 1 they are situated. Slimmer cabling can therefore be used there, whereas coarser cabling is necessary further out. In the example illustrated cables of three different dimensions are used, arranged in three correspondingly dimensioned sections 51, 52, 53 of slots 5. An auxiliary power winding 9 is arranged furthest out in the slot 5.

Figure 2 shows a step-wise stripped end view of a high-voltage cable for use in an electric machine according to the present invention. The high-voltage cable 6 comprises one or more conductors 31, each of which comprises a number of strands 36 which together give a circular cross section of copper (Cu), for instance. These conductors 31 are arranged in the middle of the high-voltage cable 6 and in the shown embodiment each is surrounded

by a part insulation 35. However, it is feasible for the part insulation 35 to be omitted on one of the conductors 31. In the present embodiment of the invention the conductors 31 are together surrounded by a first semiconducting layer 32. Around this first semiconducting layer 32 is an insulating layer 33, e.g. PEX insulation, which is in turn surrounded by a second semiconducting layer 34. Thus the concept "high-voltage cable" in this application need not include any metallic screen or outer sheath of the type that normal surrounds such a cable for power distribution.

A hydro-generator with a magnetic circuit of the type described above is shown in Figure 3 where the generator 100 is driven by a water turbine 102 via a common shaft 101.

The stator 1 of the generator 100 thus carries the stator windings 10 which are built up of the cable 6 described above. The cable 6 is unscreened and changes to a screened cable 11 at the cable splicing 9.

With a hydro-generator 100 according to the invention it is thus possible to generate extremely high electric voltages of up to approximately 800 kV. It is thus possible to electrically connect the hydro-generator 100 directly to a distribution or transmission network 110 with an intermediate step-up transformer or similar electric machine as is generally the case in conventional plants where equivalent generators are able at most to generate voltages of up of 25-30 kV.

Figure 4 illustrates a hydro-generator plant according to the present invention. In conventional manner, the generator 100 has an excitation winding 112 and one (or more) auxiliary power winding(s) 113. In the shown embodiment of the plant according to the invention the generator 100 is earthed via an impedance 103.

It can also be seen from Figure 4 that the generator 100 is electrically connected via the cable splicing 9 to the screened cable 11 (see also Figure 3). The cable 11 is provided with current transformers 104 in conventional manner, and terminates at 105. After this point 105 the electric plant in the shown embodiment continues with busbars 106 having branches with voltage transformers 107 and surge arresters 108. However, the main electric supply takes place via the busbars 106 directly to the distribution or transmission network 110 via isolator 109 and circuit-breaker 111.

A hydro-generator plant according to the invention is designed for operation either to generate electric voltage for the power network

as described above, or as a pump plant, i.e. to be driven from the electric power network 110. The generator 100 then operates as a motor to drive the turbine 102 as a pump.

Thus, with the hydro-generator 100, no intermediate coupling of a step-up transformer is required. With the hydro-generator plant according to the present invention, therefore, several transformer and breaker units previously necessary are eliminated, which is obviously an advantage - not least from the aspects of cost and operating reliability.

Although the hydro-generator and the plant in which this generator is included have been described and illustrated in connection with an embodiment by way of example, it should be obvious to one skilled in that art that several modifications are possible without departing from the inventive concept. The generator may be earthed directly, for instance, without any impedance. The auxiliary windings can be omitted, as also other components shown. Although the invention has been exemplified with a three-phase plant, the number of phases may be more or less.

CLAIMS

1. A hydro-generator plant comprising at least one rotating electric machine (100) for high voltage, in which the generator is coupled to a turbine (102) via shaft means (101), said generator (100) comprising at least one winding, characterized in that the generator (100) is provided with solid insulation and in that each winding is arranged to be directly connected via coupling elements (109) to a transmission or distribution network (110) having a voltage of between 20 and 800 kV, preferably higher than 36 kV.

2. A plant as claimed in claim 1, characterized in that the winding includes an insulation system comprising at least two semiconducting layers, each layer constituting essentially an equipotential surface, and also intermediate solid insulation wherein at least one of the layers has substantially the same coefficient of thermal expansion as the solid insulation.

3. A plant as claimed in either of claims 1 or 2, characterized in that the generator comprises a magnetic circuit with a magnetic core.

4. A plant as claimed in claim 3, characterized in that the flux paths in the core of the magnetic circuit consist of laminated sheet and/or cast iron and/or powder-based iron, and/or rough forge iron.

5. A plant as claimed in any of claims 1-4, characterized in that the solid insulation is built up of a cable (6) intended for high voltage comprising one or more current-carrying conductors (31) surrounded by at least two semiconducting layers (32, 34) and intermediate insulating layers (33) of solid insulation.

6. A plant as claimed in claim 5, characterized in that the innermost semiconducting layer (32) is at substantially the same potential as the conductor(s) (31).

7. A plant as claimed in either claim 5 or claim 6, characterized in that one of the outer semiconducting layers (34) is arranged to form essentially an equipotential surface surrounding the conductor(s) (31).

8. A plant as claimed in claim 7, characterized in that said outer semiconducting layer (34) is connected to a predefined potential.

9. A plant as claimed in claim 8, characterized in that the predefined potential is earth potential.

10. A plant as claimed in any of claims 5-9, characterized in that at least two of said layers have substantially the same coefficient of thermal expansion.

11. A plant as claimed in any of claims 5-7, characterized in that the current-carrying conductor comprises a plurality of strands, only a few of the strands being uninsulated from each other.

12. A plant as claimed in any of claims 1-11, characterized in that the winding consists of a cable comprising one or more current-carrying conductors (2), each conductor consisting of a number of strands, an inner semiconducting layer (3) being arranged around each conductor, an insulating layer (4) of solid insulation being arranged around each inner semiconducting layer (3) and an outer semiconducting layer (5) being arranged around each insulating layer (4).

13. A plant as claimed in claim 12, characterized in that the cable also comprises a metal screen and a sheath.

14. A plant as claimed in any of the preceding claims, characterized in that its stator (1) is cooled at earth potential by means of a flow of gas and/or liquid.

15. A plant as claimed in any of the preceding claims, characterized in that the outermost semi-conductor (34) is connected to earth potential.

16. A plant as claimed in any of the preceding claims, characterized in that the rotor (2) is inductively connected to the high voltage.

17. A plant as claimed in claim 16, characterized in that the rotor (2) is cylindrical in shape, has salient poles and also has a constant air gap.

18. A plant as claimed in claim 17, characterized in that the stator winding is carried out with integral slot winding.

19. A plant as claimed in claim 17, characterized in that the stator winding is carried out with fractional slot winding.

20. A plant as claimed in claim 18 or claim 19, characterized in that the stator has concentrated winding

and that coils in the winding have a coil span equal to the pole pitch.

21. A plant as claimed in claim 18 or claim 19, characterized in that the coils in the stator winding are distributed and have a coil span different from the pole pitch.

22. A plant as claimed in any of claims 5-21, characterized in that the cables (6) with solid insulation have a conductor area of between 40 and 3000 mm^2 and have an outer cable diameter of between 20 and 250 mm.

23. A plant as claimed in claim 22, characterized in that the cable (6) is cooled by gas or liquid inside the current-carrying conductors (31).

24. A plant as claimed in any of the preceding claims, characterized in that the electric generator (100) is designed for high voltage and arranged to supply the out-going electric network (110) directly without any intermediate connection of a transformer.

25. A plant as claimed in any of the preceding claims, characterized in that it comprises several generators, each of which lacks an individual step-up transformer, but which, via a system transformer common to the generators, is connected to the transmission or distribution network.

26. A plant as claimed in claim 24, characterized in that at least one generator (100) is earthed via an impedance (103).

27. A plant as claimed in claim 24, characterized in that at least one generator (100) is directly earthed.

28. A plant as claimed in any of claims 24-27, characterized in that it is designed to be driven alternatively as pump and turbine station, the electric machine (100) being arranged to function as motor driven directly from the electric power network (110) or as generator generating voltage for the electric power network.

29. A plant as claimed claim 24, characterized in that the generator is arranged to generate power to various voltage levels.

30. A plant as claimed claim 29, characterized in that one of said voltage levels is arranged to generate auxiliary power and that the auxiliary power is arranged to be generated from a separate winding (119;113) in the generator (100).

31. A plant as claimed in any of claims 1-30, characterized in that all components are earthed to the same earth system.

32. A plant as claimed in any of the preceding claims, characterized in that the winding of the generator is arranged for self-regulating field control and lacks auxiliary means for control of the field.

33. Procedure for constructing a plant as claimed in any of claims 1-32, characterized in that the stator of the generator is delivered in parts to the plant site, said parts comprising separate stator laminations and/or combined stacks of stator laminations, after which said parts are assembled on site, and in that both threading of the winding and any splicing required are performed on site.

34. An electric generator (100) for high voltage included in a hydro-generator plant in which the generator is coupled to a turbine (102) via shaft means (101), said generator (100) comprising at least one winding, characterized in that the generator (100) is provided with solid insulation and in that each winding is arranged to be directly connected via coupling elements (109) to a transmission or distribution network (110) having a voltage of between 20 and 800 kV, preferably higher than 36 kV.

35. A generator as claimed in claim 34, characterized in that it includes the features defined for the generator included in the plant as claimed in any of claims 2-32.

36. A procedure for manufacturing a generator as claimed in claim 34 or 35, characterized in that said manufacture includes the measures for assembly of the generator which are defined in claim 33.

Fig. 1

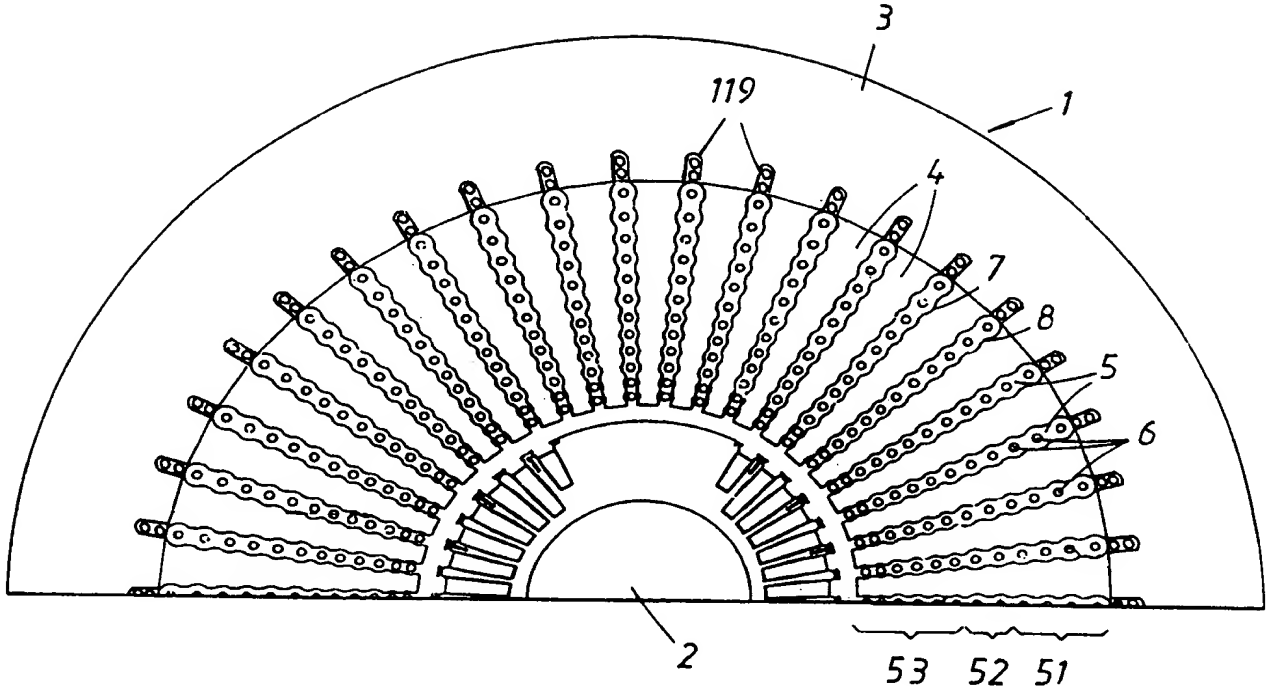

Fig. 2

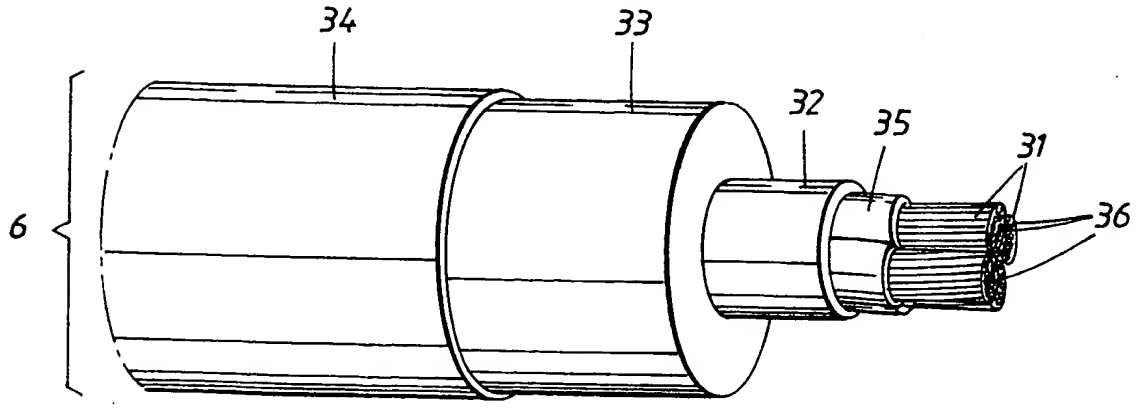

Fig. 3

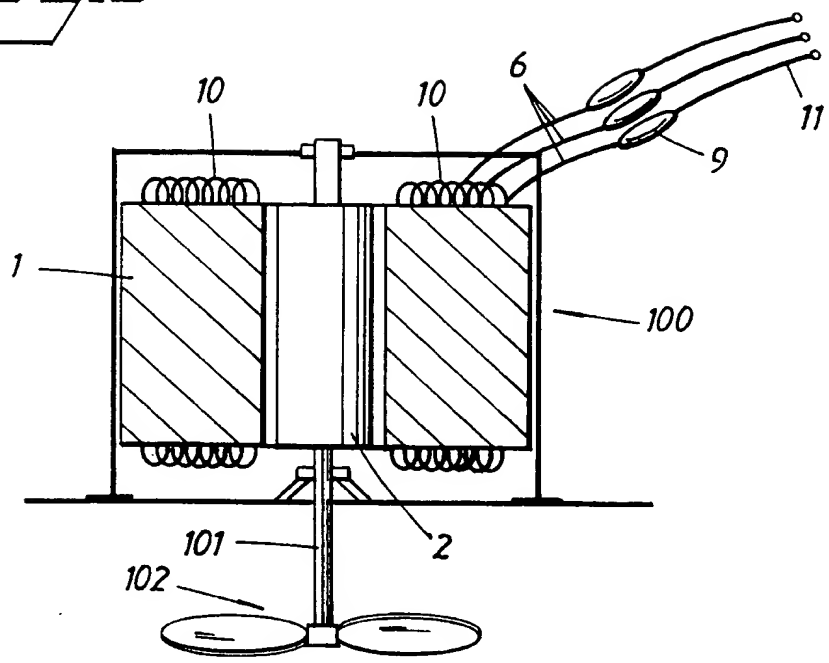
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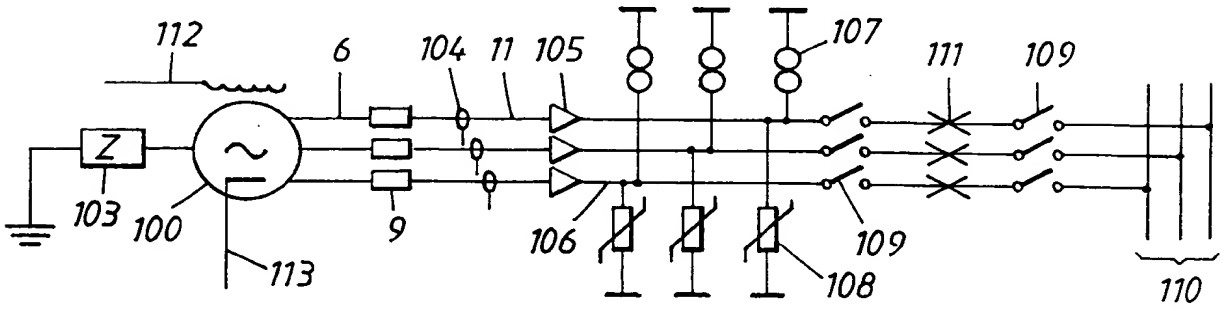
Fig. 4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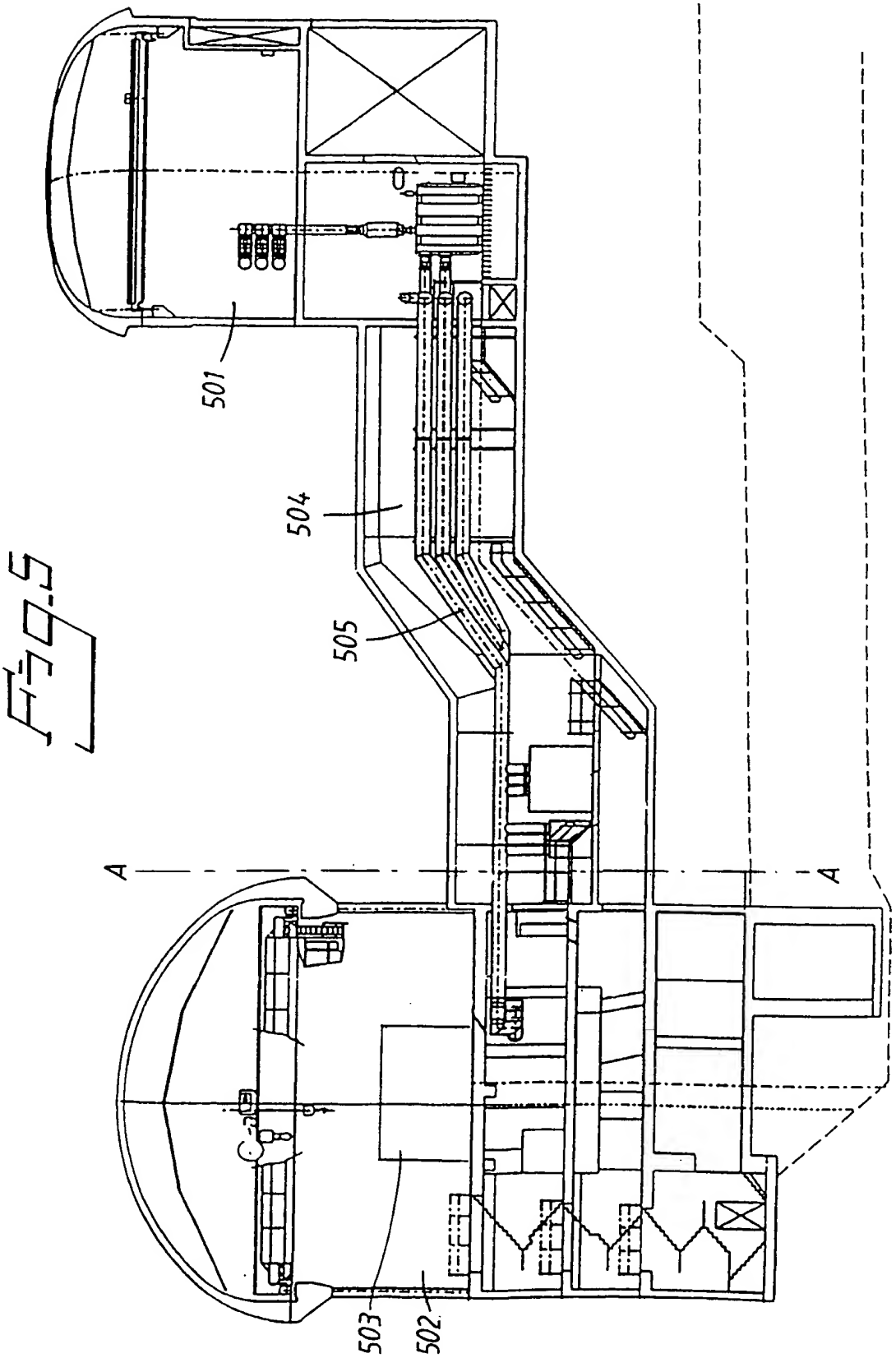


Fig.5

Fig. 6

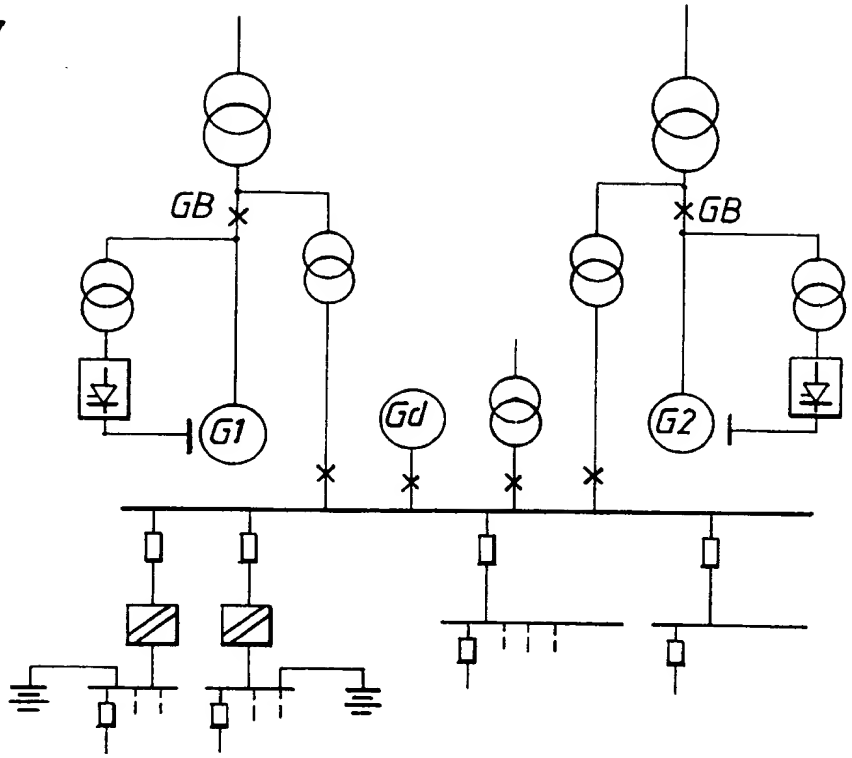
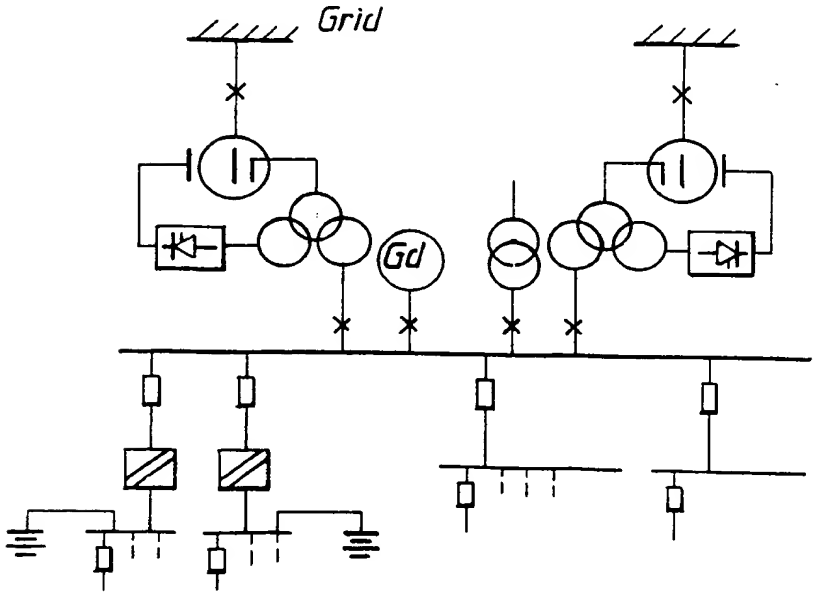


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00885

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02K 3/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4429244 A (PAVEL Z. NIKITIN ET AL.), 31 January 1984 (31.01.84), column 1, line 10 - line 58	1-36
A	US 5036165 A (RICHARD K. ELTON ET AL.), 30 July 1991 (30.07.91), see the whole document	2-33,35,36
A	US 4091139 A (JAMES F. QUIRK), 23 May 1978 (23.05.78), abstract	2-33,35,36

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 Sept 1997	19. 09. 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Magnus Hjalmarsson Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

01/09/97

International application No.
PCT/SE 97/00885

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